REMARKS/ARGUMENTS

Applicant has reviewed the final Office Action dated January 30, 2006 and the references cited therein. Claims 1-65 are pending. Reconsideration of the present application and a request for continued examination are respectfully submitted.

Rejection Under 35 U.S.C. § 102 and 103

Claims 1, 3-0, 14, 17-24, 26-36, 38-47, 49-58, and 60-65 are rejected under 35 U.S.C. § 102(e) as being anticipated by Matsuo et al. (U.S. Patent No. 6,737,716 B1). Claims 2, 16, 25, 37, 48 and 59 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Matsuo et al. (U.S. Patent No. 6,737,716 B1) in view of Morris et al. (U.S. Patent No. 5,140,383). Applicant respectfully traverses the rejection for at least the following reasons.

Matsuo discloses a method of manufacturing a semiconductor device. However, Matsuo does not disclose or teach a process that provides a source electrode and a drain electrode wherein at least one of the source electrode and the drain electrode forms a Schottky contact or Schottky-like region with the semiconductor substrate as recited in claim 1. Page 5 of the Office Action states that Matsuo teaches:

> *"...providing a source electrode and a drain electrode **305, 307, & 317** in contact with the semiconductor substrate **300** and proximal to the gate electrode **312 & 310** wherein at least one of the source electrode and the drain electrode forms a Schottky contact or Schottky-like region with the semiconductor substrate **(column 6, lines 19-59, see more details in the manufacturing method H).**"*

Review of elements 300, 305, 307, 310, 312, and 317 shows that Matsuo does not disclose or teach a process wherein the source electrode and drain electrode form a Schottky contact or Schottky-like region with the semiconductor substrate.

First, consider the structure of the source and drain electrodes in Matsuo. Matsuo teaches "after formation of the dummy gate, extension diffusion regions 305 are formed within the semiconductor substrate by ion implantation of an impurity" (see col. 31, lines 14-16). Because the extension diffusion regions 305 are formed by a process that materially changes the

semiconductor substrate 300 by ion implantation, the regions 305 are not semiconductor substrate regions following their formation by ion implantation. Later in the process, epitaxial silicon layers are selectively grown to form elevated source-drain diffusion layers 307 (see col. 31, lines 25-29) and are then ion implanted (see col. 31, lines 33-34). Note that the elevated source-drain diffusion layers 307 are formed on top of the extension diffusion regions 305. As such, the elevated source-drain diffusion layers 307 are not part of the semiconductor substrate 300.

To summarize the process up through the formation of element 307, the source and drain diffusion regions of the Matsuo device in total are comprised of extension diffusion regions 305 and of elevated source-drain diffusion regions 307 formed on top of the extension diffusion regions 305. One of ordinary skill in the art understands that when the source-drain regions 305,307 are formed from ion implantation technology, as taught by Matsuo, they are impurity doped source-drain regions and are not comprised of metal. Furthermore, one of ordinary skill in the art understands that impurity doped source-drain regions in contact with a semiconductor substrate do not form a Schottky contact or a Schottky-like region with the semiconductor substrate, but rather form p-n diode junctions at the interface between the source-drain region and the semiconductor substrate.

After formation of the elevated source-drain diffusion layers 307, and after several other process steps, Matsuo teaches the process for formation of the silicide film 317. A metal film 316 is deposited, a heat treatment is applied to form a silicide film 317, and in regions where the metal is not subjected to a silicidation reaction, the metal is removed (see col. 32, lines 27-64). To determine whether the silicide film 317 forms a Schottky contact or Schottky-like region with the semiconductor substrate, one must consider the location of the interface between the metal silicide film 317 with respect to the semiconductor substrate region 300. It is noted that the semiconductor substrate region does not include regions 305 nor 307, since they are comprised of materially different elements from the semiconductor substrate region 300 as a result of ion implantation processes.

Matsuo provides guidelines for the limits of where the location of the vertical interface of the metal silicide will be with respect to the extension diffusion regions 305. Matsu teaches:

"In order to prevent leakage current, the silicide film 317 is formed in a height of at least 60 nm from the bottom of the extension diffusion region 305. Also, the depth of the extension diffusion region 305 from the surface of the silicon substrate 300 is set at 50 nm to 60 nm" (see col. 32, lines 42-46).

Consider the limit where the height of the silicide film 317 is 60 nm from the bottom of the extension diffusion region 305, and the other limit where the depth of the extension diffusion region 305 from the surface of the silicon substrate 300 is set to 60 nm, then the bottom surface of the silicide film 317 is exactly at the top surface of the extension diffusion region 305, and furthermore, is a height of 60 nm away from the semiconductor substrate 300. As a result, the silicide film 317 forms a Schottky contact with the extension diffusion region 305, but *not* with the semiconductor substrate 300. If the height of the silicide film 317 is *more* than 60 nm above the bottom of the extension diffusion region 305, or the depth of the extension region diffusion 305 from the surface of the silicon substrate 300 is *decreased* from 60 nm, then the bottom surface of the silicide film 317 will be located within the elevated source-drain diffusion region 307 and will continue to be at least 60 nm from the bottom surface of the extension diffusion region 305, and therefore at least 60 nm from the semiconductor substrate 300. It is therefore not possible with the teachings of Matsuo to have a structure in which the silicide film 317 forms a Schottky contact or Schottky-like region with the semiconductor substrate 300. Matsuo's teachings result in the silicide layer 317 being no closer than 60 nm to the semiconductor substrate 300. One of ordinary skill in the art knows that if a layer 60 nm or greater is placed between a metal and a semiconductor, the metal does not form a Schottky contact or Schottky-like region with the semiconductor. Furthermore, it is known by one of ordinary skill in the art, that when doped source-drain devices are formed, such as the device taught by Matsuo, the contacting silicide layer such as the silicide layer 317 should generally not be in contact with the semiconductor substrate, otherwise for many materials, large leakage currents form, rendering the device much less useful. This is why Matsuo teaches the above guidelines "to prevent leakage current."

In summary, Matsuo does not disclose or teach a process that provides a silicide layer 317 in contact with the semiconductor substrate 300. As a result, Matsuo does not disclose or teach that at least one source electrode and drain electrode form a Schottky contact or Schottky-

like region with the semiconductor substrate, but rather teaches an impurity-doped source-drain device, the source-drain regions forming a p-n diode junction with the semiconductor substrate 300, not a Schottky contact or Schottky-like region with the semiconductor substrate as recited. Finally, one of ordinary skill in the art knows that for a doped source-drain device, if the silicide layer 317 contacts the semiconductor substrate 300 for conventional impurity doped source-drain technology, large leakage currents result and make the device generally less useful.

The remaining claims 2-65 also recite the features discussed above. Morris fails to remedy the deficiencies. Thus, Applicant respectfully submits that claim 1-65 patentably distinguish over Matsuo or Matsuo in view of Morris.

Conclusion

In view of the above, it is respectfully submitted that the present application is in condition for allowance. Reconsideration of the present application and a favorable response are respectfully requested.

If a telephone conference would be helpful in resolving any remaining issues, please contact the undersigned at 612-752-7367.

Respectfully submitted,

DORSEY & WHITNEY LLP
Customer Number 25763

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By: _____
Min (Amy) S. Xu
Reg. No. 39,536